

# ***PARADIGM SHIFTS & THEIR IMPLICATIONS FOR THE AEROSPACE INDUSTRY***

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**“Paradigm Shift” is one of the most popular, and most misunderstood, terms in American culture today.**

- What does the term really imply?
- What are the potential impacts on the Aerospace industry?
- How can paradigm shifts be fully leveraged?



# Origins of Term...

‘These thoughts reminded me of a book I read years ago. In *The Structure of Scientific Revolutions* (Chicago, 1962) Thomas Kuhn writes that science isn't a steady, linear accumulation of knowledge. Rather it's "a series of peaceful interludes punctuated by **intellectually violent revolutions**.

These revolutions aren't created by committee or by those trying to improve theories that worked before. They come from individuals who “see that **[the old] rules no longer define a playable game.**”

**Kuhn called these revolutions paradigm shifts.** Yes, this thoughtful book is the source for that abused term. For Kuhn, a new paradigm sweeps away the ones that proceeds it.’

Passage from Digital Video Magazine editorial, Feb. 2001



## Origins of Term...

Simply summarized, Paradigm Shifts are

radical changes in **reference frame**

that help to explain **conflicting observations**

in times of **rapid underlying volatility**

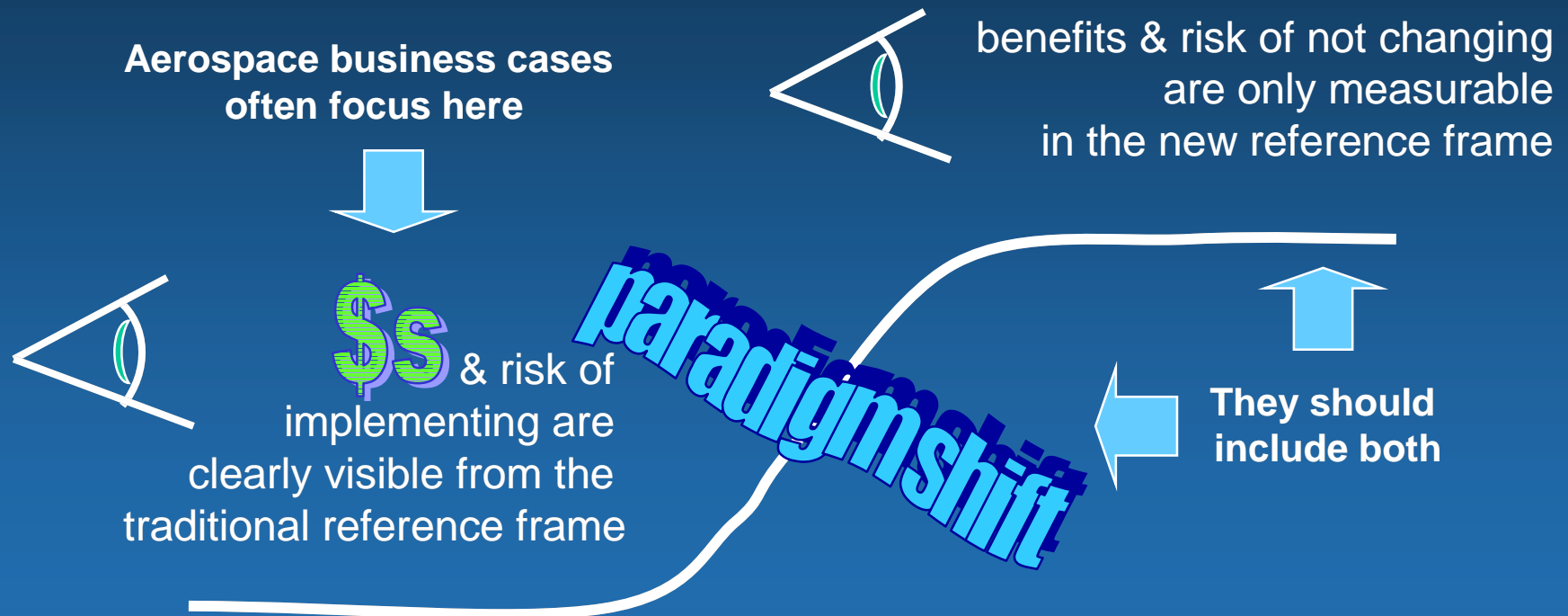
and that offer **new solution perspectives**



- Because paradigm shifts are not widely recognized, or are measured within existing “Reference Frame” metrics, they typically **run counter to common wisdom**.
  - *Small, evolutionary changes are frequently mistaken for the real revolutionary changes that need to be made*
- Paradigm shift revolutions **occur relatively quickly** and carry an **inherent sense of urgency**
  - *Phased approaches are typically a tip off that the urgency is not recognized; and therefore, the “shift” opportunity will not be fully leveraged, ultimately reinforcing arguments against change*



- Paradigm shifts only make sense when **measured in the reference frame of the shift**





- Existing business practices encourage evolutionary change, not the required **revolutionary change**
  - *Traditional competitive pressure*
  - *Rote design by committee / past experience*
  - *Perceived risk & cost avoidance*
  - *Traditional rewards & incentives*
- As a result, the aerospace industry has not been able to fully leverage the benefits of paradigm shift opportunities as reflected in :
  - *Addressing performance & affordability simultaneously*
  - *Generating customer & stock holder enthusiasm*
  - *Avoiding surprises (i.e., schedule slips, cost over runs, part mismatches, etc.)*



- Paradigm shifts **can be devastating** to those that miss catching their essence

~~vacuum tubes~~  
~~transistors~~

~~vinyl records~~  
~~tapes & CDs~~

~~analog watches~~  
~~digital watches~~

~~foot soldiers~~  
~~chairs~~  
~~warfare~~

~~parachutes & airplanes~~  
~~Maentz Line~~



# Some of Today's Paradigm Shift Drivers



- Changing market place
  - *More competition (traditional & non-traditional)*
  - *Changing customer tastes*
  - *Desire for more immediate gratification*
- Changing product expectations
  - *Affordability & performance (faster, better, cheaper, not 2(or 1) out of 3)*
  - *Reliability*
- Changing threats
  - *Predictable monolithic threat replaced by many unpredictable threats*
- More demanding missions
  - *Mars vs. orbital or the Moon*
- More rapid advances in technology
  - *Change market place, expectations, threats, missions & competition*



- Miscues
  - *Monitoring the competition*
    - At best, always playing catch up
    - Traditional competition is equally confused by revolutionary concepts
  - *Ignoring changes*
    - Paradigm shifts empower new competitors who will change



- **Market volatility is a catalyst**
- **Technology is an enabler**
  - *It was not transistor technology that changed the world, but the recognition by Sony of a whole new paradigm of affordable consumer electronics, enabled by transistor technology*

# *Illusivity of Paradigm Shift - An Experiment*



- Put your name on your sheet of paper and answer the 3 following questions.
- 1. What is the color of a fire truck ?
- 2. What is the color of a yield sign ?
- 3. What is the color of an orange ?
- Hint : **Blue, green, yellow, orange or red**
- Answers & discussion in a moment

## 4 Technologies (Paradigm Shift enablers)

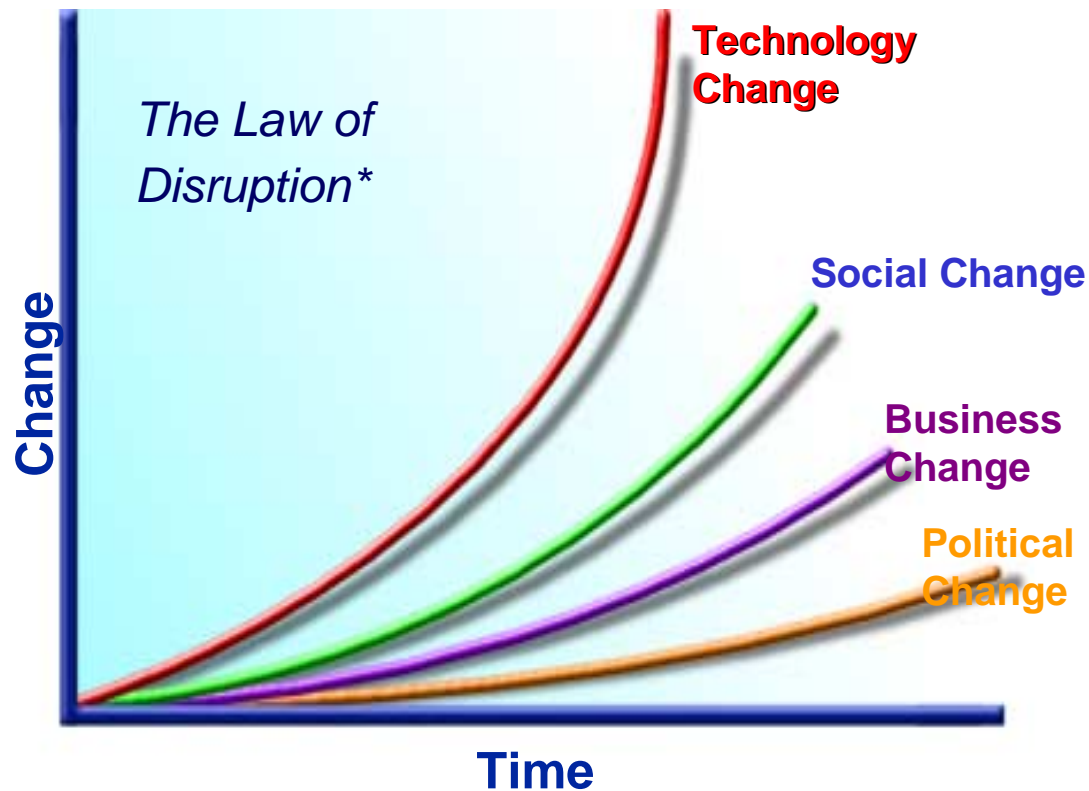


- *Model centric product development*
  - Smart product model concepts including 3D parametric solid modeling, attributes capture, & design reuse
- *Process simulation*
  - Including digital ergonomics, virtual reality, digital mockup, etc.
- *Direct manufacturing*
  - Stereolithography, selective laser sintering, & LENS
- *Web related technology*
  - Capture, organization, management, & access to product information

cross dependent enablers to an overarching enterprise shift  
that address performance, cost, & schedule

# What's needed?

*Strong DoD & Service Understanding & Emphasis*



- **Technical**
- **Cultural**
- **Managerial**
- **Budgetary**
- **Technology-centric**

Zittel @ 2001 SMART Conference after  
Killer Apps; Chu, Wang

*Social, Political and Economic Systems Change  
Incrementally, but Technology Changes Exponentially!*

## 4 Paradigm Shifts *(enabled by the 4 technologies)*

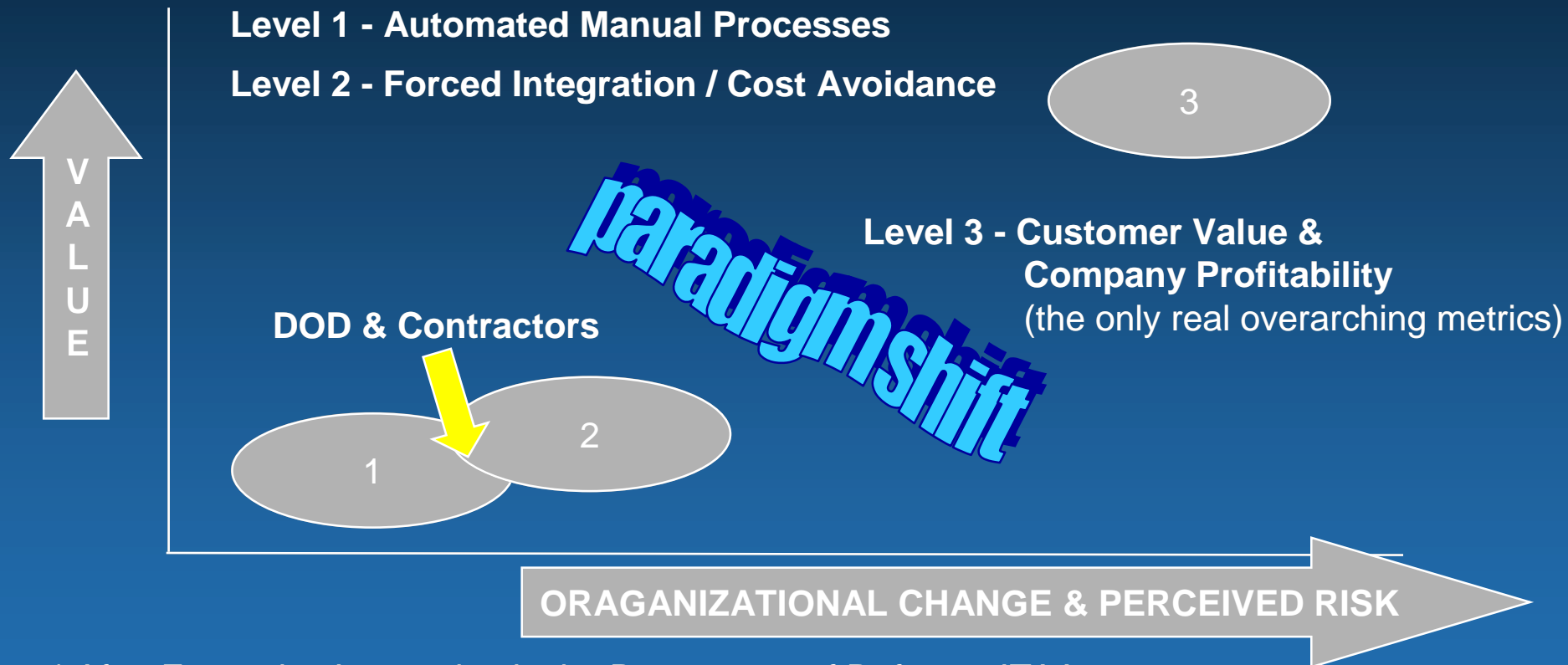


- **Affordability** (customer “reference frame” / market place driven)
  - *Driven by changing priorities in the market place*
  - *A long term struggle for the aerospace industry*
  - *Includes performance, not in lieu of performance*
- **New American Security Force** (mission driven)
  - *2 Squadrons of customized airplanes per year*
  - *3 year “requirements to ramp” development cycle*
- **Digital prototype** (technology driven)
  - *Goes to the heart of ADP’s bread & butter*  
*(Both a threat & an opportunity)*
  - *Complements physical prototyping by optimizing designs, fab, & integration & by avoiding surprises*
  - *Potential to eliminate EMD cost & schedule*  
*(i.e., the prototype is the 1st production vehicle)*
- **Lean thinking**
  - *formalized approach to driving out waste & variance*

# Enterprise Integration - Another Paradigm Shift



- Three levels of Enterprise Integration\*



\* After Enterprise Integration in the Department of Defense, ITAA, 1993

improvement requires change; change requires risk



# Recognition of the Need for Revolutionary Change Is Increasing



- NASA Intelligent Synthesis Environment
  - “to *revolutionize* NASA’s engineering process”
- SoD Rumsfeld’s top priority
  - “to create the military of the 21st century by taking advantage of the ongoing technological *revolution*”
- Reengineering the Corporation & Lean Thinking
  - *revolutionary* paradigm shifts implemented as a comfortable evolution in the aerospace industry
- *Economist Technology Quarterly* “In Praise of Disruption”
  - “even the biggest... are *feeling the heat of feisty upstarts* and are having to *reinvent themselves continuously* to stay alive”
- Spencer Johnson (author of The One Minute Manager) in Who Moved My Cheese
  - “old beliefs do not lead to change”



- Many revolutionary shifts occurring that, when embraced by an agile organization/company, will drastically change the aeronautics industry as we know it.
- Imagine a paradigm shift where 20 top people form a company which leverages technology & paradigm shifts to meet NASF objectives
  - *What would be the effect on traditional aerospace organizations?*
  - *Or alternatively:*



- A paradigm shift where a company offers to “rent” 2 new squadrons of airplanes each year to the government , complete with maintenance and support, using the technologies & shifts to reap obscenely high profits
  - *Government gets the vehicles they need, when they need them at a fixed & reasonable price with no risk*
  - *The company generates larger profits on a smaller resource base by leveraging internal efficiency*  
*(No progress payments during 3 years of development and production )*
  - *Greatly reduced industry / government peripheral activities*
  - *Traditional organizations are out of business*

we are masters of our own destiny, good or bad

# Back to the Test



- What color are yield signs? How did you answer?
  - *Yellow of course. Having asked this question to hundreds of people, less than ten have said anything else.*
- But there is a great lesson here.
  - *Yield signs have been **red** with white trim for going on 15 years.*
  - *If we can not see the color of a physical object that we've seen everyday for over 10 years, isn't plausible that we can not see the complex paradigm shifts that are critical to the success of our company ?*
  - *Furthermore, the majority view does make it the correct view. Yield signs are not yellow because we all think they are & paradigm shifts don't go away because we don't see them!*





- Mastering paradigm shifts is critical to our future. We have to stop “seeing” yellow yield signs, and seek out & leverage the revolutions in which we find ourselves.
- **Suggested Directions**
  - **Recognition** - acknowledge the need for change - quit playing by “rules that no longer define a playable game”
  - **Education** - Across the board, top to bottom training to understand the traits of paradigm shifts - to understand how to use alternate reference frames
  - **Process** - establish a formal mechanism to assist in identifying & accepting shifts
  - **Scope** - shift the focus from “manageable and convenient” to broad sweeping, revolutionary improvement
  - **Reassessment** - determine how best to play in this new environment, how to more rapidly identify and adjust to paradigm shifts
  - **Action** - move quickly to gain competitive advantage through technology and process shifts
  - **Reward** - align rewards & incentives to encourage the benefits of revolutionary improvements



- Who Moved My Cheese is a book specifically about the subject of change:
- Spencer Johnston, the author, has his own similar recommendations:
  - *Change happens*
  - *Anticipate change*
  - *Monitor change*
  - *Adapt quickly to change*
  - *Change*
  - *Enjoy change*
  - *Be ready to change quickly and enjoy it again*



## Summary of Key Characteristics

- Revolutionary, not evolutionary
- Not widely seen (because they're in another reference frame)
- Must be measure in the frame of reference of the shift
- Occur quickly and generate urgency
- Can be devastating to those that don't react quickly
- Open the door for new players
- Can be driven by a number of factors including technology, marketplace, or mission





- Revolutionary changes, “paradigm shifts”, are taking place that will fundamentally reshape the aerospace industry
- Paradigm shifts explain many of the things we see going on around us, & offer us an improved understanding of what we need to do
- Aerospace organizations must master the concept of paradigm change (I.e., thinking in new reference frames), & drive the changes to leverage their full benefit



*The winning strategy for the future is to quit playing by the old rules that no longer define a playable game !*